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GEMINI 4 FLIGHT

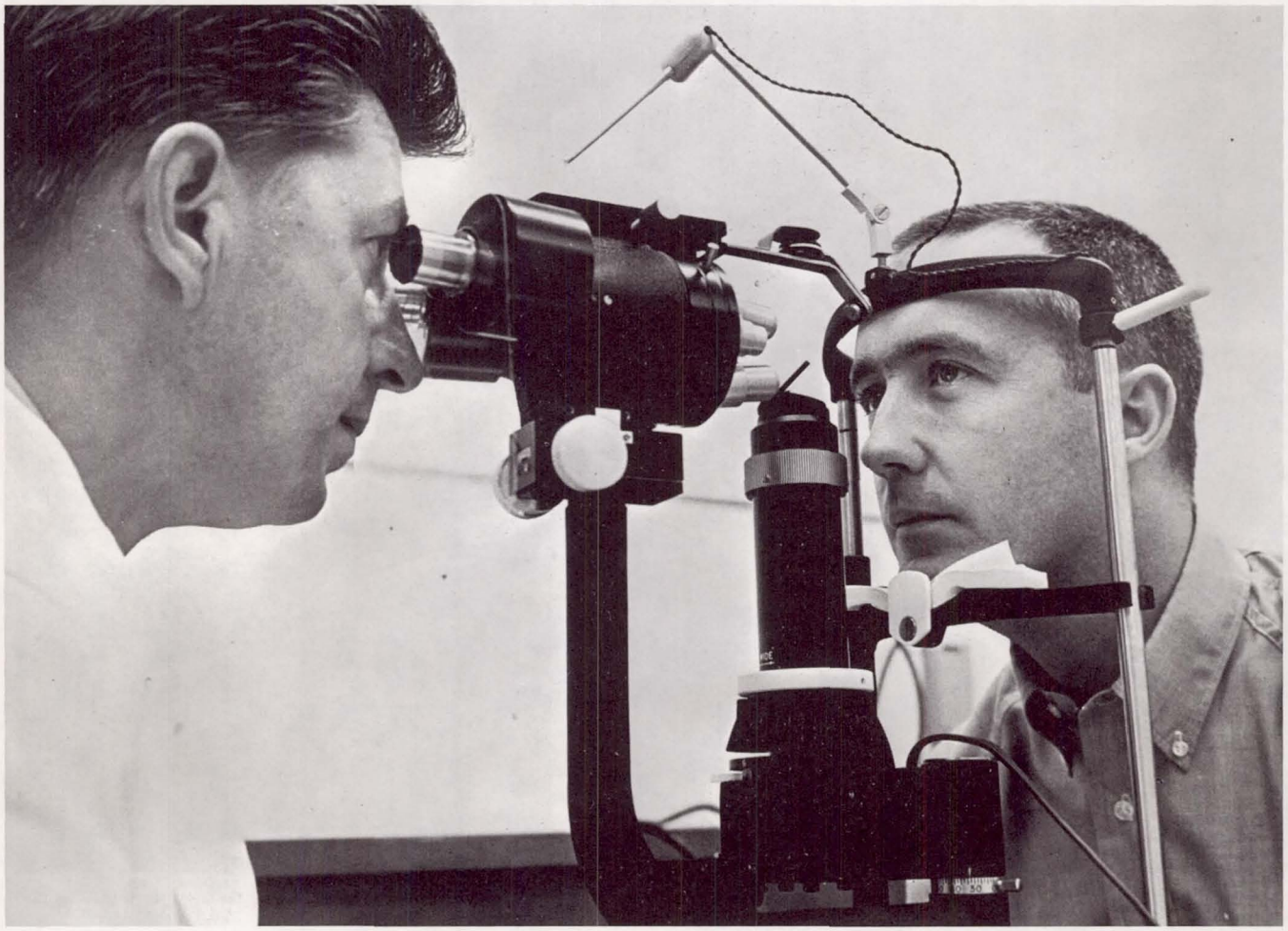
Astronauts James A. McDivitt and Edward H. White II were selected as command pilot and pilot, respectively, for the Gemini 4 (GT-4) mission on July 27, 1964.

Almost 11 months later, on June 3, 1965, McDivitt and White lifted off from Cape Kennedy, Florida, on a four-day mission which provided a number of firsts in American space history. During the interim they were busy with a variety of activities which would prepare them for that flight.

They started an intensive training schedule in order that they might be prepared to meet the mission objectives. This schedule included refresher courses in many fields of the overall astronaut training program. It also included many hours of training for the extra vehicular activity (EVA) although that activity was not approved for the flight until May 24, ten days before the mission, due to the fact that qualification tests on the EVA equipment were not completed until mid-May.

GEMINI 4 EXTRAVEHICULAR ACTIVITY — Astronaut Edward H. White is shown as he performed his maneuvers outside the spacecraft during the third revolution of the four-day flight.

THE GEMINI 4 FLIGHT CREW, McDivitt, left, and White are shown above using a celestial navigation aid to study the constellations they expected to see on their flight. Below McDivitt receives an eye examination from Air Force Lt. Col. James F. Culver during the comprehensive physical examination undergone by both pilots two days prior to the start of the mission.



Also, during the interim, McDivitt and White "practically lived" with their spacecraft from its assembly stage in the McDonnell Aircraft Corporation until after the mission.

At the completion of all simulated flights and, with the mission given a "GO" by the Mission Director, the crew was given a final physical examination two days before the flight and pronounced ready to go.

The crew was awakened at 4:10 a.m. on the morning of the flight, and following a brief physical examination and the traditional breakfast with invited guests, they left their Merritt Island quarters at 5:22 a.m. and arrived at the suit-up area at 5:35 a.m. The body medical sensors were attached, they were suited and left the area for the launch pad shortly after 7 a.m. McDivitt and White arrived at the launch complex at 7:08 a.m. and stepped into the spacecraft four minutes later. During the period in the suit-up area the crew was briefed on early countdown activities and checks by the backup command pilot Frank Borman. Backup pilot James Lovell remained in the spacecraft to continue these checks until shortly before the arrival of the crew.

The countdown for the GT-4 flight ran smoothly until T minus 35 minutes. At this time difficulty was encountered in lowering the launch vehicle erector tower. The hold to solve this problem lasted one hour and 16 minutes — then the countdown proceeded uninterrupted and Gemini 4 lifted off the pad at 10:16 a.m. (EST).

FLIGHT OBJECTIVES

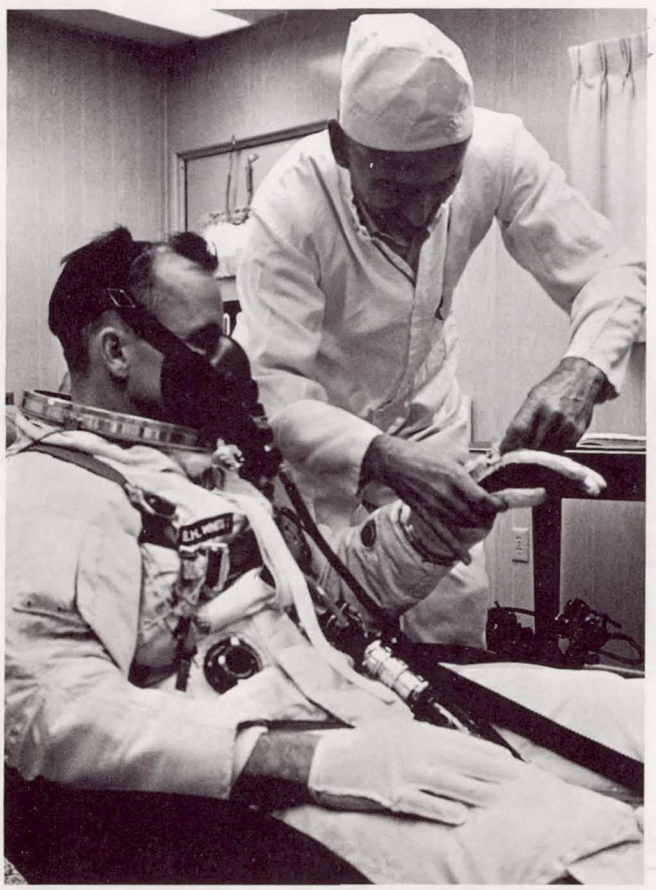
Major objectives of the Gemini 4 mission were:

- To demonstrate and evaluate the performance of the spacecraft's systems for a period of approximately four days in space; and
- To evaluate the effects of prolonged exposure of the flight crew to the space environment in preparation for flights of longer duration.

Other objectives assigned to the mission were:

- To demonstrate extravehicular activity;
- To conduct station keeping and rendezvous activities with the second stage of the launch vehicle;
- To demonstrate the capability of making significant in-plane and out-of-plane maneuvers;
- To demonstrate the capability of the orbital attitude and maneuver system to operate as a backup to the retrograde rocket system; and
- To execute 11 experiments.

All of these objectives were met with two exceptions. A decision was made late in the first revolution not to attempt the rendezvous with the launch vehicle's sec-



GEMINI SUIT TECHNICIAN Joe Schmitt, right, helps White suit up on flight day. At the same time, White was breathing pure oxygen in order to purge his body of nitrogen before the flight. This was necessary because of the planned depressurization of the spacecraft for the EVA.

LAST WALK BEFORE A LONG RIDE — Astronauts McDivitt and White, are shown as they walk up the ramp at Pad 19 on the morning of the flight. McDivitt smiles broadly as White gives the traditional "thumbs up" signal to media representatives, contractor and NASA personnel on the pad at the time.

ond stage because the fuel allotted for this activity had been used up during the station keeping exercise (remaining within a set range) with the second stage. A computer-controlled reentry was not flown because of an inadvertent alteration of the computer memory during the 48th revolution. This alteration occurred during an attempt to remove power from the computer following an apparent malfunction of the computer power-down circuitry. Consequently, a rolling reentry was made as had been done on all Mercury flights.

The Gemini 4 spacecraft landed in the Atlantic about 50 miles short of its intended target, the aircraft carrier "Wasp", at 12:12 p.m. (EST) on June 7 after completing 62 plus revolutions of the earth in an elapsed time of 97 hours and 56 minutes. Just 30 minutes later the astronauts emerged from the spacecraft and were picked up by a helicopter to be transported to the "Wasp." They touched down on the carrier's deck at 1:09 p.m., (EST) just 57 minutes after their four-day space flight had ended. This mission was successfully completed at 2:29 p.m. (EST) with the recovery of the spacecraft by the "Wasp."

POSTFLIGHT NEWS CONFERENCE

A postflight news conference was conducted at Houston about 30 minutes after the crew landed on the carrier deck with NASA and Department of Defense personnel as participants. Taking part were Dr. George E. Mueller, Associate Administrator for Manned Space Flight, NASA; Dr. Robert R. Gilruth, Director of Manned Spacecraft Center; Maj. Gen. Vincent G. Huston, Assistant DOD Manager for Manned Space Flight Operations; Christopher C. Kraft, Jr., Assistant Director of MSC for Flight Operations, who also served as both Mission Director and Flight Director for Gemini 4; Charles W. Mathews, Gemini Program Manager, MSC; and Dr. Charles Berry, Chief of MSC Medical Operations.

Following the introduction, each of the participants spoke briefly before the conference was thrown open for questions. Dr. Mueller acknowledged the support of everyone in the industry-government-DOD team which made the success of the mission possible. He also pointed out that at least two world firsts had been accomplished during the flight — for the first time two men spent four days in orbit; and, for the first time extravehicular activity was carried out with a propulsive device which permits man to maneuver free of his spacecraft in space.

Dr. Gilruth added his gratification to the entire team and emphasized the part played by the Mission Control Center at Houston, used to control a mission for

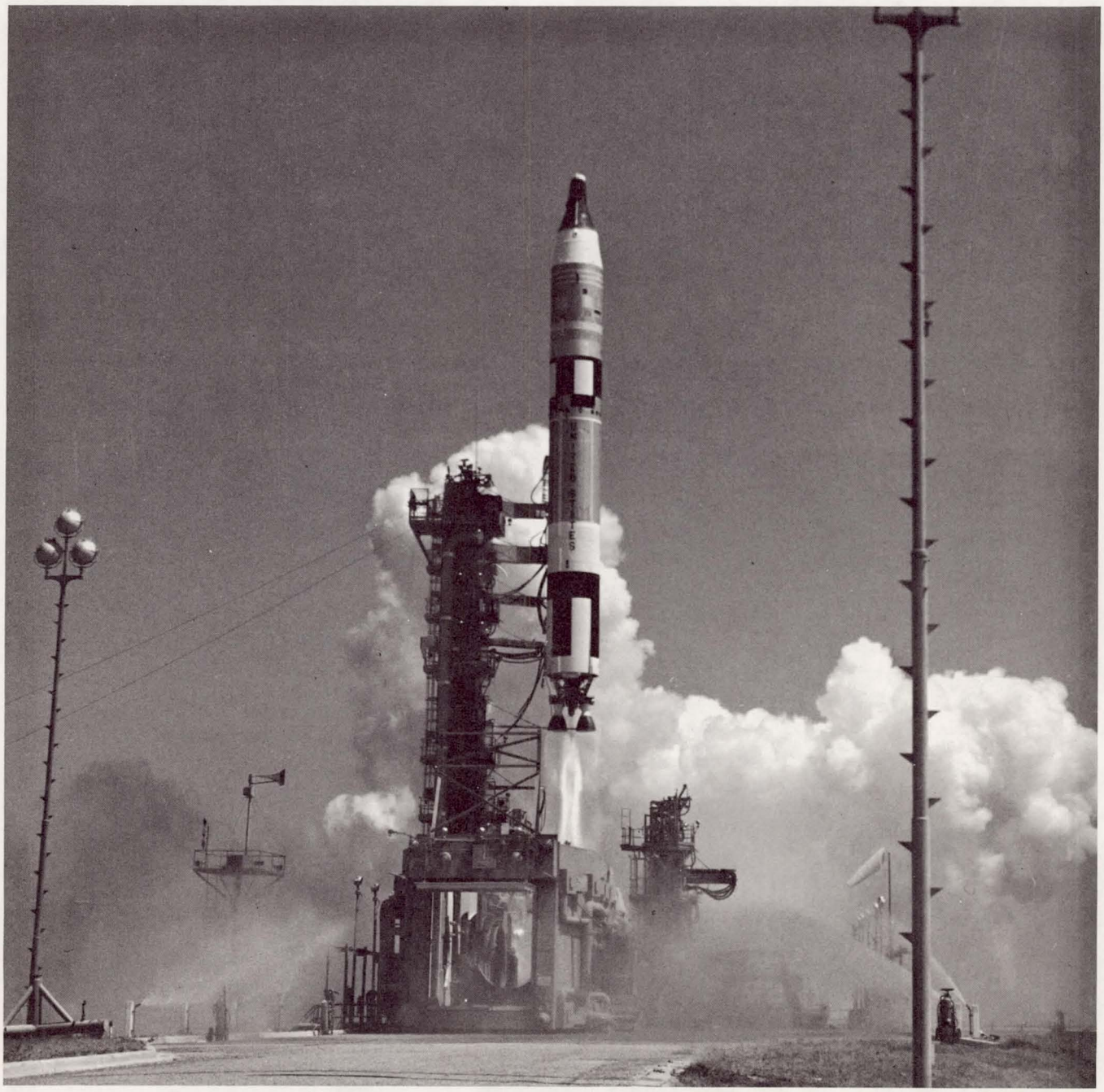
ONBOARD AND READY TO GO — The Gemini 4 flight crew are shown inside their spacecraft just prior to the time the hatches were closed during the final phase of the countdown.

the first time in the Gemini 4 flight. General Huston, Kraft, Mathews and Berry, added their personal praises for the teamwork exhibited.

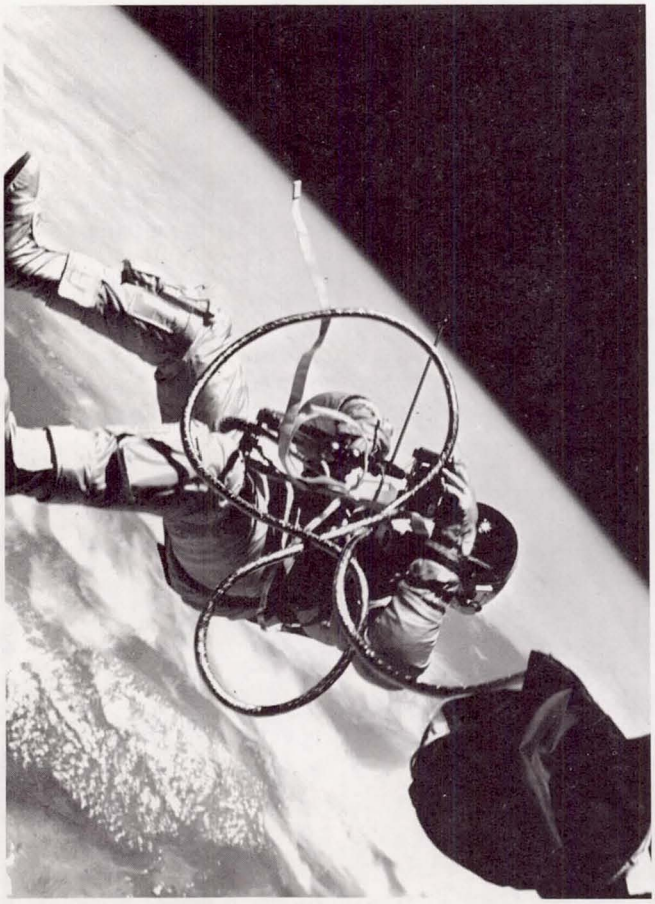
During the question and answer session, Dr. Berry pointed out that early indications were that the crew were in excellent physical condition. He said that he felt results of this flight would prove there were no serious effects to crew members as a result of four days of weightlessness; that the idea the heatload would be too great during reentry was refuted (readings in the spacecraft on the water immediately following landing indicated a spacecraft temperature of 70); and the contention of some people that extravehicular activity could not be accomplished because of vertigo had been disproved.

Mathews, in answer to a question about the computer problem and possible effects that problem might have on the next scheduled flight, said: "I don't anticipate that type of problem would cause a delay. Of course, we do have a failure analysis — we're taking immediate steps. We're already setting up a meeting with all the people involved to determine just how to handle the various guidance and control equipment that might be involved. I expect we'll find the answer fairly early for that class of failure. Failures in electronic equipment can generally be rectified quite rapidly."

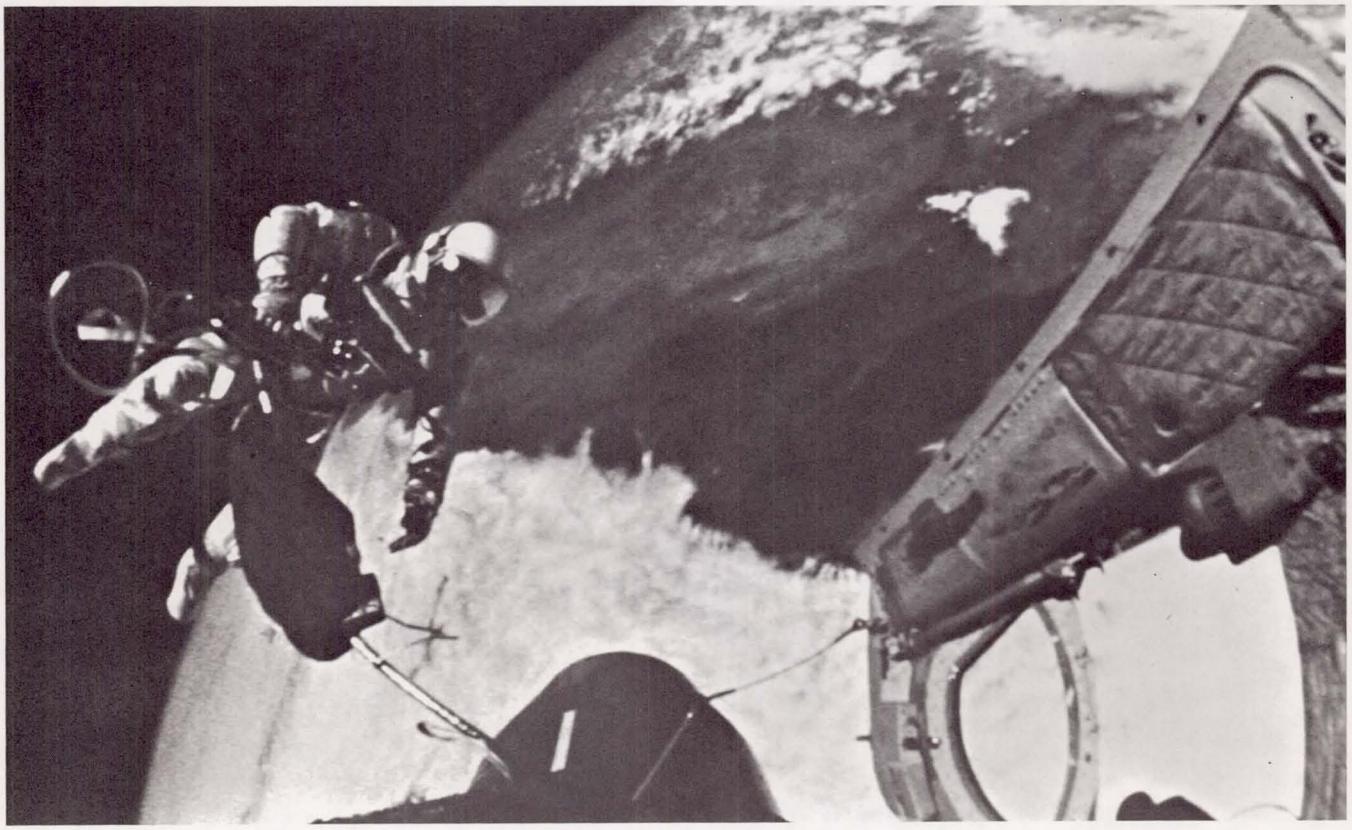
He added that he was quite surprised at how nominally the spacecraft had behaved during the four-day flight. He said all the temperatures, pressures and fuel



THE GEMINI 4 LIFTS OFF from Launch Pad 19 at Cape Kennedy at 10:16 a.m. (EST) on June 3, 1965.



Above and below are additional pictures taken of White by the command pilot as he went through various maneuvers during his 20 minutes plus outside the spacecraft.



A DOWNRANGE RECOVERY AREA WELCOME — White and McDivitt are shown as they stepped from the recovery helicopter onto the deck of the aircraft carrier USS Wasp to be greeted by Capt. J. W. Conger, commander of the Wasp, left, and Rear Admiral W. H. McCormick, commander of Carrier Division 14, Atlantic Fleet. Below the two bearded astronauts huddle even more closely than they did in their spacecraft to accept the congratulations of President Lyndon B. Johnson.

consumption were quite predictable and "about as steady as a rock." At this point, Kraft said: "I think you ought to say there, Chuck, that the performance of the environmental control system was far above anything we've ever expected it to be. We never had any moisture problem in the spacecraft during the whole flight. And the relative humidity stayed almost constant from liftoff to landing."

FLIGHT CREW NEWS CONFERENCE

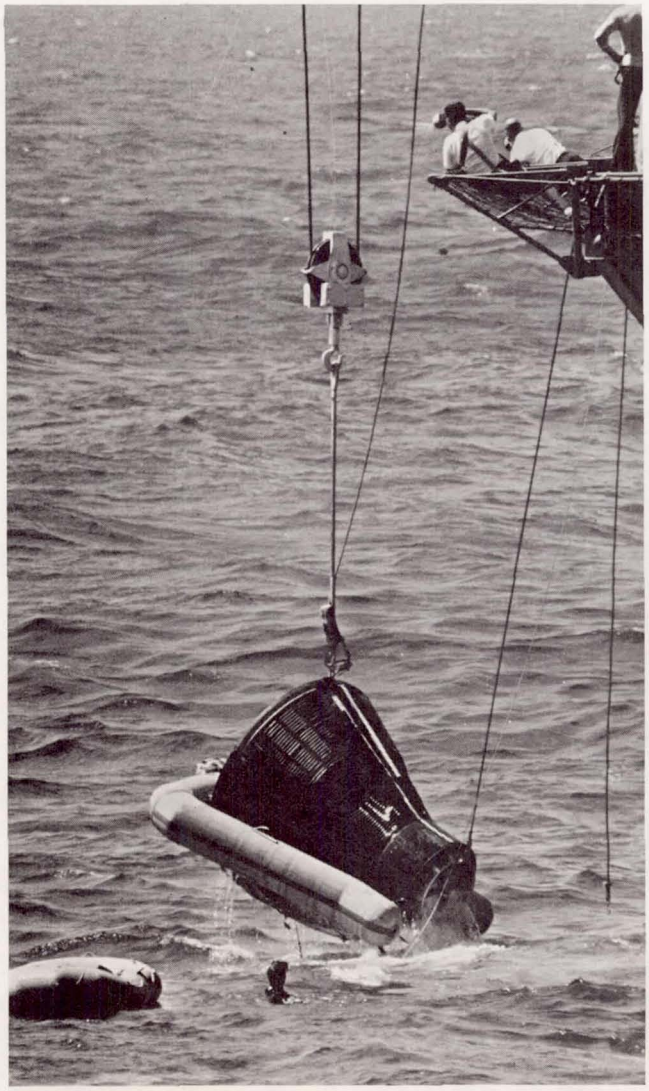
McDivitt and White were the principals at a news conference at Houston four days after they completed their flight. During the interim period they had undergone a series of medical and technical debriefings. Dr. Robert C. Seamans, Associate Administrator of NASA; and Dr. Robert R. Gilruth, Director of Manned Spacecraft Center, made brief remarks to start this conference.

The pilots alternated in covering various phases of the mission. McDivitt started by discussing the launch and first orbit, during which an effort was made to stay with the second stage of the launch vehicle; White described the extravehicular activity; McDivitt told of the exercises conducted during the long period which followed the EVA; and White described the activities

connected with preparation for reentry and during the actual reentry and rescue operation.

McDivitt said that at the completion of the turnaround maneuver after separation of the launch vehicle, the spacecraft was less than 600 feet in front of it and off to one side of it. He also noted that the second stage was tumbling and that the tumbling rate increased rapidly. McDivitt made continual attempts to close the distance between the spacecraft and the launch vehicle stage but the latter fell away so rapidly that by the time the spacecraft came out of the night side for the first time the crew estimated it was several miles away from them and well below them. Additional use of the thrusters in an attempt to narrow the distance failed and McDivitt recommended to Flight Director Chris Kraft that they not make any further attempt at rendezvous because of the major expenditure of fuel involved and Kraft agreed.

During the first pass of Gemini 4 over the United States, the crew started preparation for the extravehicular activity. White said that McDivitt took the check list and went through it with him, item by item, as he donned the equipment. This checkout progressed smoothly but after both pilots felt they were being hurried to complete the preparation in time, they decided to postpone the EVA to the following revolution, and they notified the flight director of their decision.



THE GEMINI 4 SPACECRAFT is shown as it was hoisted aboard the carrier with its flotation collar still attached.

The crew then had an ample amount of time to go through the checklist again and to check and double-check all the equipment required for America's first attempt of putting man into space without the protective cover of a spacecraft.

When all the equipment was ready, the crew depressurized the spacecraft to two pounds per square inch to make certain the suits would hold the 3½-pounds per square inch pressure they were to use during the EVA. The suits were working well and McDivitt depressed the cabin to vacuum shortly after receiving a "GO" for that operation from the flight director as they passed the Carnarvon, Australia Tracking Station.

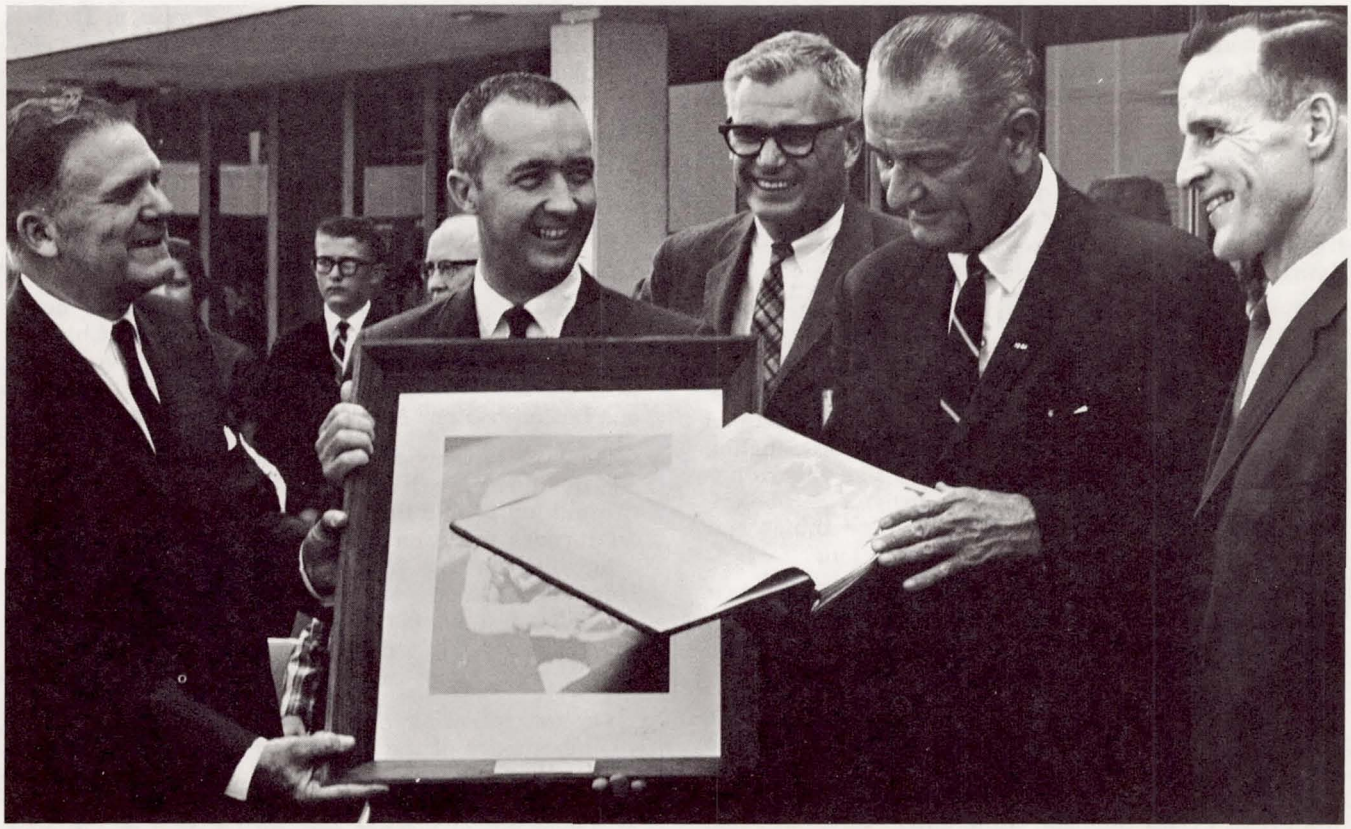
They were prepared and ready as they reached Hawaii and Kraft gave them approval to start the EVA at that time. White was outside the spacecraft about 23 minutes.

In describing the activity, White said in part, "The gun actually provided the impulse for me to leave the spacecraft . . . I maneuvered approximately down the center line of the spacecraft perhaps favoring just a little on the right." Speaking of his maneuvers from that time, he said that he started to yaw around left with the gun, and added that he knew that "we actually had something with the gun because it was actually providing me an opportunity to control myself where I wanted to go out there. The control was actually what we were trying to demonstrate in our EVA operation. We knew a little bit about the tether dynamics but we wanted to actually find out how well a man outside the spacecraft could control himself with a maneuvering unit and in later parts of the EVA we wanted to find out how well the man could control himself with the tether."

Speaking of their long drifting portion of flight, McDivitt said that it was impossible to cover that phase in a sequential order, although the crew learned a lot about eating and sleeping in space, performing real time flight planning, and provided much data for the medical people on the ability of men to function in the weightless environment during a long-duration mission.

Both pilots described the view during reentry as beautiful. McDivitt said, in part, ". . . we saw pink light coming up around our spacecraft, it got orange, then red, and pretty soon we saw green. It was the most beautiful sight I've ever seen. The thing that impressed me most about the reentry was that we were actually able to see the ground."

During the question and answer period which followed. White was asked whether he felt some reluctance about coming back into the spacecraft. He replied, "Well, I can tell you in all sincerity and honesty that I enjoyed EVA very much. I thought it was a wonderful opportunity that I had to represent the people of our country in this endeavor, and, I can also



ABOVE, President Johnson looks over a Gemini 4 souvenir photo album, presented to him during his visit to Manned Spacecraft Center by the flight crew. Left to right: NASA Administrator James E. Webb, McDivitt (holding a framed photo of White during EVA), NASA's Associate Administrator Dr. Robert C. Seamans Jr., President Johnson, and White. Below, McDivitt speaks in a Rose Garden ceremony at the White House as the flight crew presents a flag carried in Gemini 4 spacecraft to the President. Left to right, foreground, are McDivitt, White, President Johnson and Vice President Hubert H. Humphrey.

tell you honestly I was sorry to see it draw to a close. About being reluctant to come back in, I suppose personally I was reluctant to come in . . . but there was no doubt in my mind that when the flight director told me this phase of the mission was over it was time to come back in."

In answer to another question, White said he had absolutely no sensation of falling while he was out of the spacecraft. He compared the sensation he had to flying over the earth from about 20,000 feet.

The difficulty in closing the hatch, following EVA, was discussed and, in this connection it was pointed out that in preparation for the mission the pilots had completely disassembled the hatch and put it together themselves. McDivitt said, "This is one of the reasons that it takes so long to prepare for one of these flights. You just can't cover every eventuality like this rather insignificant thing — at least it was insignificant before flight. You really can't train for all these things and cover them all unless you do it hard and long."

Both pilots were asked whether they thought it would be possible for a man to spend 12 to 14 days in a spacecraft and work effectively and if they would be willing to do it.

In response to these questions, McDivitt said, "Yes, I think it would be possible for a man to do this. I think the things we've learned — the things that I specifically learned — are that we've got to rearrange our work-rest cycles a little differently than we had planned. I think if we start out like this a man will be rested. I think there's enough room in the spacecraft to do this. We came back without a single pressure point on our bodies from our pressure suits. I think this is pretty interesting. We didn't have any effects from our weightlessness. Now maybe longer duration might, but I don't think so. We've got to provide sufficient food and water and rest periods for people in space the same way that we do on the ground. I don't think there should be any problem. I'd be willing to do it."

White said, "Yes, I'd be happy to answer it. Jim, I think, very adequately expressed most of my feelings on it. And I want to say one other — amplify one other point that Jim brought out. The food that we had along on the flight . . . it was very apparent to me that after four or five hours, if I didn't take a meal, I felt like I was slowing down a little bit and it was more pronounced than when I get hungry here. I tend to be hungry quite often here, but up there when I got hungry my energy level went down considerably. And each time I'd take a meal it was like a shot in the arm. My energy level went — boomed right up — back up to the level that it had been prior to the time that I'd kind of run out of gas from lack of food . . . the point I'm making is that we can go the long duration flights but I think we have to be sure that we provide adequate food. I think Jim went through the same cycle each time that he didn't eat and as soon as he ate we were right back up on a good working level. The food was very important."

POSTFLIGHT ACTIVITIES

There were a number of postflight activities which involved the GT-4 crew. On June 11 President Lyndon B. Johnson visited Manned Spacecraft Center and congratulated the flight crew as well as all who had participated in the program. A highlight of that visit was the unexpected announcement by the President that he was nominating both McDivitt and White for one-grade promotions to Lieutenant Colonel, in the Air Force. The White House later announced that all astronauts would receive a one-grade promotion following their first successful flight.

Two days later, McDivitt and White were honor guests at a dinner sponsored by the Houston Chamber of Commerce. This affair was the start of a very busy week for the crew which had spent four days seeing no one but each other in very cramped quarters.

On June 14 they were recipients of a ticker-tape parade in Chicago with an estimated crowd of more than two million people lining the parade route — the largest turnout ever reported in that city. They were accompanied on this ride by Vice President Hubert H. Humphrey. Other activities in Chicago included speaking to 3,000 students in a theater, being made honorary citizens of the city, and watching a giant fireworks display in their honor that evening.

On the following day, McDivitt and White, both 1959 graduates of the University of Michigan in aeronautical engineering, journeyed to Ann Arbor, Michigan. There they received honorary degrees as Doctor of Astronautical Science and participated in a ribbon-cutting ceremony to open a $1.7 million space research laboratory.

On June 16 both pilots were honored by their home towns. McDivitt was feted at Jackson, Michigan, with a parade witnessed by 125,000. He was presented with a gold windshield wiper — a reminder that during the EVA White had brushed against his windshield and left a mark on it. On that same day, White was honored at San Antonio, Texas, where a crowd estimated at 150,000 lined a parade route. During activities that day, White placed a wreath at the entrance to the Alamo.

The two crew members were reunited in Houston, and on June 17, along with Charles W. Mathews and their families, flew to Washington for activities there. During ceremonies in the Rose Garden at the White House, President Johnson presented the NASA Exceptional Service Award to both McDivitt and White, and the NASA Outstanding Leadership Award to Mathews. The astronauts, in turn, presented a small flag they had carried on their space journey to the President.

Following the White House ceremony the group was taken in a motorcade up Pennsylvania Avenue to the Capitol. While there they visited both Houses of the Congress and the astronauts were presented with the flags which flew in front of the East and West wings of the Capitol during their flight. That evening they were honor guests at a State Department dinner. One of the highlights of the day was an invitation by the President to McDivitt, White, Mathews and their families to spend the night as his guests in the White House. This surprise was topped later when the President informed them they were to leave for Paris the following

morning to attend the Paris Air Show which was in progress at that time.

On Friday, June 18, McDivitt, White, and Mathews, accompanied by Vice President Humphrey and James E. Webb, NASA Administrator, boarded the President's plane for the trip to Paris. They were accompanied by their wives. The group was met at Le Bourget Airfield by a crowd estimated at 15,000 people despite the fact that the trip was made on short notice. One of the highlights of the Paris trip was the meeting between McDivitt and White and Cosmonaut Yuri Gagarin at lunch at the Air Show the following day.

EVA CAPABILITY DEVELOPMENT

Extravehicular activities have been a major objective of the Gemini Program since its initiation. Development of equipment with which to perform this activity has taken place over a period of several years. Several factors were instrumental in the decision to attempt EVA on the Gemini 4 flight.

First, the Gemini 4 spacecraft was basically the same spacecraft as that used on the Gemini 3 mission, and, due to the performance of the GT-3 spacecraft, many of the questionable engineering areas had been answered. In fact, the tests of the GT-4 spacecraft at the McDonnell Aircraft Corp. plant were completed in about 60 per cent of the time required for similar tests on the GT-3 spacecraft.

Secondly, the extravehicular equipment program developed rapidly during the months just preceding the GT-4 flight and the completion of the qualification testing of this equipment was completed in sufficient time to permit inclusion of the activity on the flight.

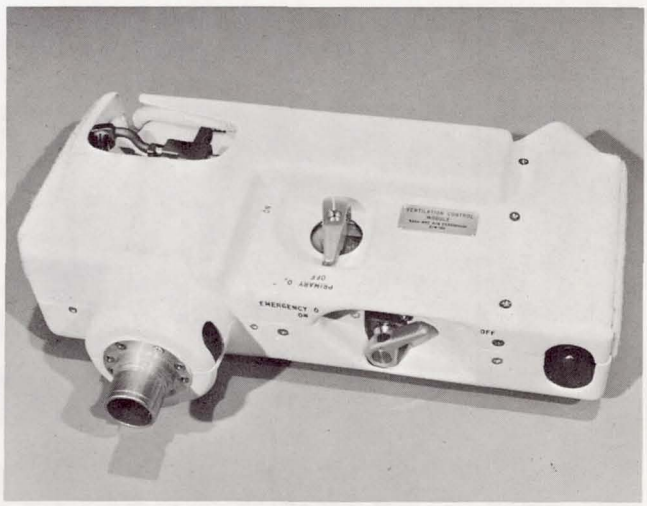
Following are the major milestones in the development of this capability.

- Gemini suit development was initiated during the first quarter of 1961. The features of the suit encompassed an extravehicular capability with only moderate modifications of the basic design required at a later date.

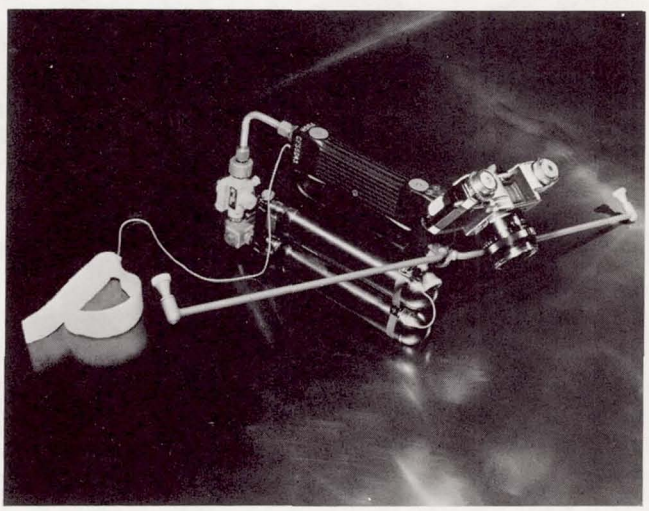
- In early 1964, specific extravehicular suit features were initiated; the umbilical design was initiated; initial zero-g ingress and egress tests were performed; and development of extravehicular life support equipment was initiated.

- In November 1964, the hatch of the GT-3 spacecraft was opened during altitude chamber tests.

A CUTAWAY VIEW showing the various layers of the Gemini Extravehicular Space Suit.



A CLOSEUP VIEW of the chest pack worn by White during EVA, above, and the hand held self maneuvering unit, below.



• In January 1965, White started a series of zero-g ingress and egress exercises.

• In March 1965, a decision was made for White to open the hatch and stand up at 150,000 feet during the GT-4 altitude chamber tests. Also, during that month, the first extravehicular suits were delivered.

• In April 1965, the first manned altitude chamber runs with the GT-4 EVA equipment were made.

• In mid-May 1965, qualification testing of all GT-4 EVA equipment was completed and White completed altitude chamber runs at 180,000 feet using this equipment.

• On May 24, 1965, the decision was made to include the EVA in the flight plan for the GT-4 flight.

• In addition, White trained with the hand-held self maneuvering unit on a specially designed simulator at Manned Spacecraft Center. This device enabled him to become accustomed to the movements he would make in space through use of the unit.

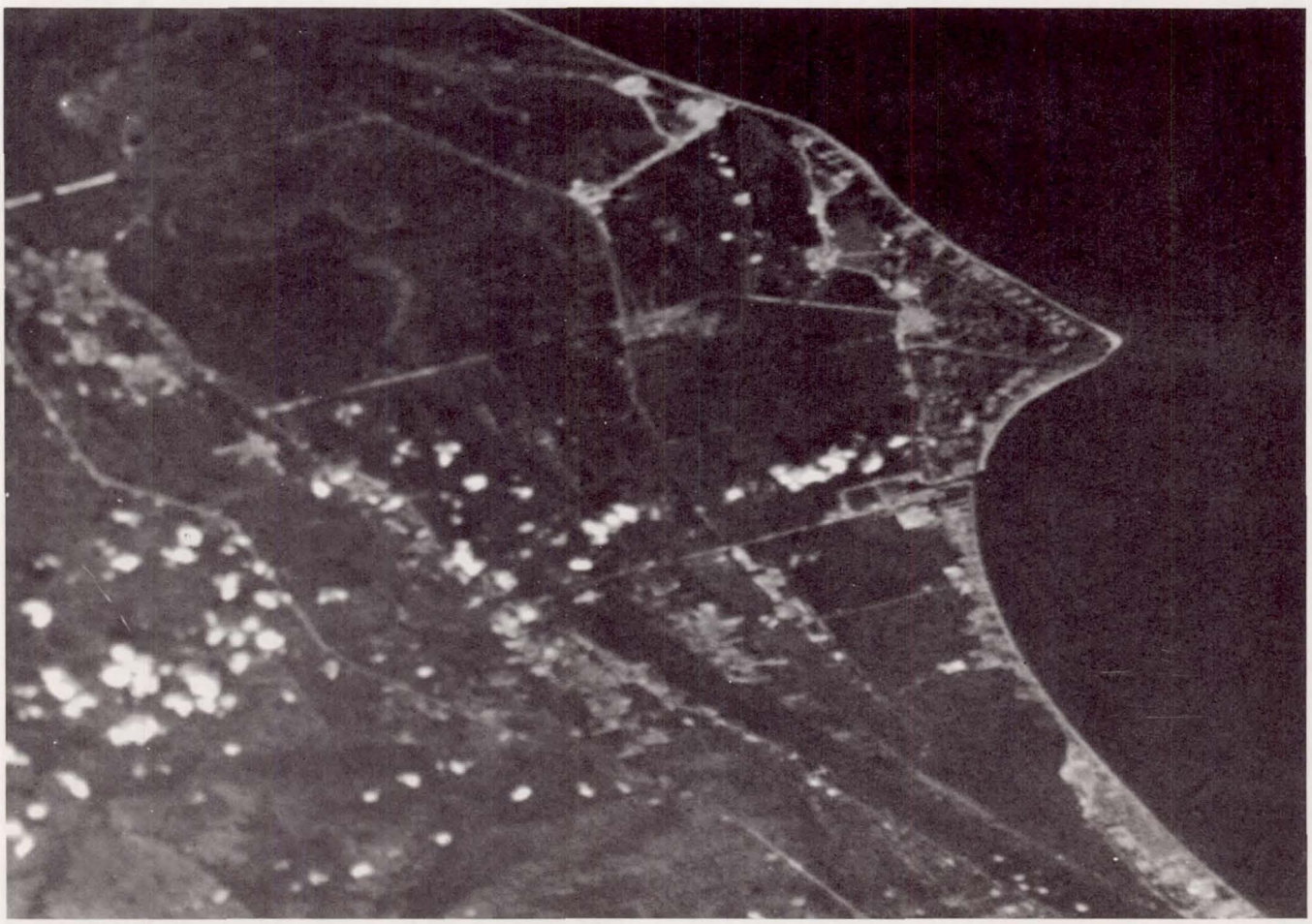
Total extravehicular suit usage time prior to the flight was 200 hours, including 60 hours with White in the suit; 10 long duration extravehicular manned tests of the extravehicular systems tests were completed; and White had completed 110 egress/ingress runs under zero-g conditions.

EVA EQUIPMENT

As noted previously, a modified Gemini suit was used for the EVA. This suit consisted of a cotton undergarment, a cotton comfort layer, a rubber pressure layer, a layer of Link net, seven layers of aluminized mylar insulation (interspaced with six layers of non-woven Dacron) for thermal protection, a thick felt layer for meteoroid protection, and a white reflective outer layer of nylon.

The EVA suit weighs approximately 34 pounds as compared to 24 pounds for the regular Gemini suit. The suit was fabricated by the David Clark Company. The umbilical cord is manufactured by Garrett AiResearch. This cord is wrapped in Scotch plastic tape and was gold-coated and heat-treated. The cord itself was about one inch in diameter and included a one-half inch flat nylon tether, a silicone rubber oxygen hose with an inside dimension of one-quarter inch, four electrical leads, and a communications lead. Total length of the umbilical cord was about 25 feet and its weight was slightly over nine pounds. The nylon tether was a 1,000-pound test line and the umbilical was designed so that all the strain was on the tether. The tether was attached to the elbow restraint of the pilot's spacecraft seat with the other end attached to the D ring of the parachute harness.

The chest pack used by White was developed at



SPACE PHOTOGRAPHY — Cape Kennedy, Florida, as seen from Gemini 4. This photo obtained with a hand held camera from more than 100 miles up demonstrates the clarity of objects on the ground from that height. The Saturn V launch complexes are seen in the upper center of the picture.

Manned Spacecraft Center. It was 13 inches long, six inches wide, and two inches deep. This pack was designed to regulate the suit pressure at a constant rate. It also provides an oxygen supply which can be used in case of a failure in the umbilical supply.

The other item used during the EVA was the handheld self maneuvering unit, also developed and fabricated at Manned Spacecraft Center. This unit permitted White to move right or left, front or back, or up or down as he desired. The unit used during GT-4 provided only a minimum of "fuel" for maneuvers. The propulsion used was pure oxygen. A camera was attached to this unit which White could trigger with his left hand. Total weight of the maneuvering unit was seven-and-a-half pounds.

GT-4 EXPERIMENTS

There were 11 scientific, medical, technological and engineering experiments conducted during the Gemini 4 flight. Because of the nature of these experiments, only a preliminary evaluation of the results are available at this time. Detailed evaluation can be made only after completion of the Gemini program after the results of the individual experiments have been compiled since many of the experiments are to be made on a number of flights. A rundown on experiments conducted on GT-4 follows.

• Radiation in Spacecraft — The objective of this experiment was to determine the absorbed radiation dose rate and the total dose that penetrated the cabin of the spacecraft.

Available data indicates conclusively that there is no radiation hazard associated with manned space operations at present Gemini altitudes. The principal experimenter was the Research and Technology Division of the Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico.

• Simple Navigation — There were two basic goals assigned to this experiment. One was to gather information on the observable phenomenon which could be best used for autonomous space navigation (that is, an horizon and celestial object examination). The other was to gather information on the use of a sextant-type device in an earth-orbiting vehicle in order to define the man-sextant-vehicle problems involved in the use of this type of instrument for space navigation and rendezvous.

Available data indicates that this experiment produced valuable information concerning the utility of the Gemini spacecraft windows, the thickness of the various horizons and their upper boundaries, and the ability of man to make celestial sightings from an orbiting spacecraft. The principal experimenter was the Research and Technology Division, Air Force Avionics Laboratory, Wright-Patterson Air Force Base, Ohio.

• Electrostatic Charge — The objective was to detect and measure any accumulated electrostatic charge on the surface of a Gemini spacecraft during a typical mission.

Evaluation of the data on this experiment will be accomplished as they become available. The principal experimenter is the Radiation and Fields Branch, Advanced Spacecraft Technology Division, Manned Spacecraft Center.

• Proton-Electron Spectrometer — The objective of this experiment was to detect and measure the flow and energy of protons and electrons present throughout typical revolutions, and especially within the South Atlantic geomagnetic anomaly.

Preliminary examination of the data recorded indicates that the proton flow and number of electrons encountered outside the anomaly was very low. This experiment was also conducted for the Radiation and Fields Branch of MSC.

• Tri-Axis Magnetometer — The objective of this experiment was to determine the magnitude and direction of the geomagnetic field in the South Atlantic anomaly and to support the previously described Proton-Electron Spectrometer experiment with additional data.

Further analysis and comparison of data with that from other flights must be made before final results can be determined.

• Two-Color Earth's Limb Photographs — The object of this experiment was to obtain photographs of the earth's limb in an effort to determine the excess elevation of the blue limb over the red. Postflight measurements of the photographs were planned to determine if the elevation of the earth's limb can be a reliable aid in future manned space flight guidance and navigation sightings.

The results of this photography will be combined with those taken on previous and later manned flights. The principal experimenter was the Instrumentation Laboratory, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology, Cambridge, Massachusetts.

• Synoptic Terrain Photography — The objective was to obtain high-quality color photographs of terrain features for geological and geographic purposes. Pictures were taken of well known areas, such as the United States, which could serve as standards for interpretation of lesser known areas; and of remote areas which were poorly covered by photography previously.

This experiment was classified as a complete success. It is anticipated that the photographs obtained will be of great value for geological studies. In addition to exhibiting good color, they include a wide variety of geological features such as mountain masses, volcanic fields, folded mountains and deserts. The Theoretical Division, NASA Goddard Space Flight Center, Greenbelt, Maryland, conducted this experiment.

• Synoptic Weather Photography — The objective was to obtain high-quality color photographs of a number of selected clouds and meteorologically interesting weather systems. Another objective was to obtain photographs of areas concurrently viewed by the TIROS satellite in order to aid in interpretation of the high-altitude satellite television photographs.

This experiment was also classified as a complete

success. More than 100 photographs were obtained of cloud systems of all types. The experiment was conducted by the National Weather Satellite Center, U. S. Weather Bureau, Suitland, Maryland.

• Inflight Exerciser — The objective was to assess cardiovascular reflex activity in response to a given physical workload and the general capacity of performing physical work under zero-g conditions. The inflight exerciser consisted of a pair of rubber bungee cords attached to a handle at one end and to a nylon strap at the other. Exercise periods consisted of one pull per second for 30 seconds and 63 pounds of pull were required to pull to a full extension.

Conclusions reached as a result of this experiment were that exercise periods should be programmed in the mission flight for both crew members and that each medical pass should include an exercise period. The experiment conducted by the Space Medicine Branch, Crew Systems Division, MSC.

• Inflight Phonocardiogram — The objective was to measure the time interval between the electrical activation of the heart muscle and the onset of the muscular contraction of a man in space. This time interval is a measure of the fatigue-state of the muscle and is used to provide insight into the functional cardiac status of the pilots during prolonged space flight.

Data on the results of this experiment are not available. This experiment was also conducted by MSC's Space Medicine Branch.

• Bone Demineralization — Objective of this experiment was to investigate the occurrence and degree of any bone demineralization from prolonged space flights. Such demineralization has been observed in humans during periods of immobilization such as bed rest and during other situations involving physical inactivity.

Current analysis does not provide any conclusions, to date, on the results of this experiment. The experiment was conducted by the Nelda Childers Stark Laboratory for Human Nutrition Research, Texas Women's University, Denton, Texas.

GT-4 OPERATIONAL CONTROL

The Gemini 4 flight marked the first time that a manned space mission was controlled from the Mission

GT-4 CONTROL was exercised from the newly completed Mission Control Center in Houston, Texas, from liftoff through recovery. This view of the Control Room was taken minutes after the start of the flight. The position of the spacecraft at that time can be seen on the map located in the front center of the room.

FLIGHT DIRECTORS for the Gemini 4 mission are shown around the Flight Director's console in the control room. Left to right, front, Eugene Kranz, Flight Director of the White Team; and Christopher C. Kraft Jr., Flight Director of the Red Team. Kraft also served as Mission Director of the GT-4 flight. Standing, left to right, are Glynn Lunney, Flight Director at Mission Control Center at Cape Kennedy during the pre-launch countdown and the launch phase; and John Hodge, Flight Director of the Blue Team.

Control Center in Houston, Texas. This facility proved beyond any doubt that it is operationally qualified to take over such control following the launch at Cape Kennedy, Florida.

In addition, the duration of the Gemini flight required that flight controllers go on a three-shift basis for the first time. Christopher C. Kraft, Jr., Assistant Director of Manned Spacecraft Center for Flight Operations, served during GT-4 in a dual capacity — both as Mission Director and Flight Director. The other two flight directors for GT-4 were Eugene Kranz and John Hodge.

Other positions in the Mission Control Room manned by key personnel on an around-the-clock basis were Assistant Flight Director, Operations and Procedures Officer, Spacecraft Communicator, Guidance and Navigation System Engineer; Electrical, Environmental, and Communications Engineer; Flight Dynamics Officer, Retrofire Controller, Guidance Officer, Network Controllers, and Flight Surgeons.

In addition to the personnel required to man these positions, there were approximately 250 additional NASA and contractor employees named to special assignments in Mission Control Center as required support personnel.

To further add to the burden placed on the controllers, there was an added requirement to have a team of flight controllers at the Mission Control Center at Cape Kennedy, Florida, during the countdown and launch phases of activities. Gylnn Lunney was flight director of this team.

Other flight controllers were stationed at sites around the world for necessary activities. Command Communicators, Systems Engineers, and Flight Surgeons were located at Grand Canary Island; Carnarvon, Australia; Kauai, Hawaii; Corpus Christi, Texas; Guaymas, Mexico; and on two tracking ships in the Pacific — the COASTAL SENTRY and the ROSE KNOT.

Speaking of the operation of the Control Center during the postflight news conference, Dr. Mueller said, in part, ". . I'd like to particularly compliment the people in Mission Control Center for an outstanding operation — this is the first time that Control has been from this site — and it was as smooth an operation as I have seen. ."

THE PILOTS

Both members of the Gemini 4 flight crew were among the group of astronauts named by NASA in September 1962.

James A. McDivitt, the command pilot, was born in Chicago, Illinois, June 10, 1929. McDivitt is five

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feet-11 inches tall, weighs 155 pounds, and has brown hair and blue eyes. He is married to the former Patricia Ann Haas of Cleveland, Ohio, and they have three children — Michael, 8; Ann Lynn, 7; and Patric, 5. McDivitt's parents, Mr. and Mrs. James McDivitt, live in Jackson, Michigan.

He attended Jackson Junior College from 1948 to 1950, then joined the Air Force in 1951. During the Korean action, McDivitt flew 145 combat missions in F-80's and F-86's and was awarded three Distinguished Flying Crosses, five Air Medals, and the Choo Moo Medal from South Korea.

McDivitt attended the University of Michigan and was graduated in 1959 with a Bachelor of Science degree in aeronautical engineering. He is also a graduate of the Air Force Experimental Test Pilot School and the Air Force Aerospace Research Pilot Course. Prior to his selection by NASA, he served at Edwards Air Force Base, California, as a test pilot.

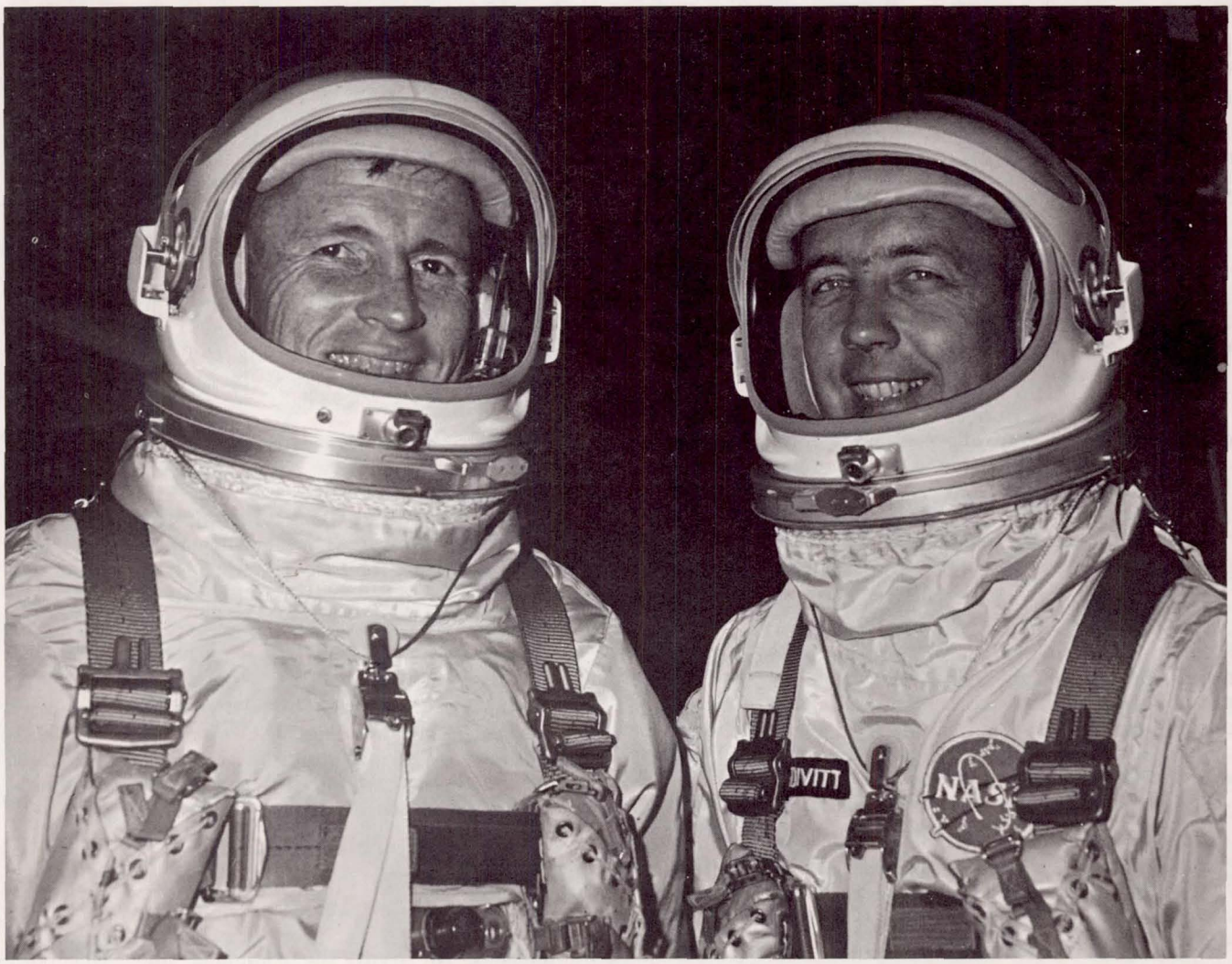
He is a member of the Society of Experimental Test Pilots and the American Institute of Aeronautics and Astronautics. He has logged more than 3,000 hours flying time, including more than 2,500 hours in jet aircraft.

The pilot, Edward H. White II, was born in San Antonio, Texas, November 14, 1930. He is six feet tall, weighs 171 pounds, and has brown hair and brown eyes. White is married to the former Patricia Eileen Finegan of Washington, D.C., and they have two children — Edward, 12, and Bonnie Lynn, 9. White's parents, Maj. Gen. (retired) and Mrs. Edward H. White, reside at St. Petersburg, Florida.

White received a Bachelor of Science degree from the United States Military Academy in 1952, and received a Master of Science degree in aeronautical engineering from the University of Michigan in 1959.

He is also a graduate of the Air Force Test Pilot School. Prior to becoming an astronaut, he was assigned at Wright-Patterson Air Force Base, Ohio, as an experimental test pilot with the Aeronautical Systems Division.

White is a member of the Institute of Aerospace Sciences; a member of Sigma Delta Psi, athletic honorary; and a member of Tau Beta Pi, engineering honorary. He has logged more than 3,600 hours flying time, including more than 2,200 hours in jet aircraft.



THE GEMINI 4 FLIGHT CREW — pilot Edward H. White II, left, and command pilot James A. McDivitt.